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INVESTIGATION TO RELATE CHLOROPHYLL & SUSPENDED SEDIMENT CONTENT IN WATERS OF LOWER CHESAPEAKE BAY TO ERTS-1 IMAGERY(TASK 2)	6. Performing Organization Code
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16. Abstract

Objective of the project is to correlate multispectral imagery from the Earth Resources Technology Satellite to estuarine water character. Chesapeake Bay is used as a study area, and chlorophyll, suspended particulates, and turbidity is being monitored during satellite overpasses. Correlation of ground truth to satellite data will determine the usefulness of multispectral imagery in surveying estuarine water character and circulation without the aid of ground truth, and will result in criteria that will maximize the usefulness of satellite imagery for this purpose.

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INTRODUCTION

The objective of this project is to correlate multispectral imagery from the Earth Resources Technology Satellite to estuarine water character. We are using lower Chesapeake Bay as a study area, and are monitoring primarily chlorophyll, suspended particulates, and turbidity during satellite overpasses. Correlation of ground truth to satellite data will determine the usefulness of multispectral imagery in surveying estuarine water character and circulation without the aid of ground truth, and will result in criteria that will maximize the usefulness of satellite imagery for this purpose.

REPORT

Ground truth--chlorophyll and sediment analysis

Ground truth data has been collected for the October 10, December 3, and January 26 satellite overpasses.

To date this program continues to suffer due to the lack of satellite data. There have been three dates (Oct. 10, Dec. 3, 1972; and Jan. 26, 1973) when the weather permitted satellite coverage of this area. We have received data for the Oct. 10 and Jan. 26 passes, and only partial coverage for the Dec. 3 pass.

Ground truth data has been collected for each of the above dates. Much more structure in the water than was anticipated is visible in the images. Because of this, it may become necessary to modify our ground truth procedures to obtain continuous records of chlorophyll as well as sediments. This can only be decided after more ERTS data have been received. Regardless of whether or not this will become necessary, plans are being made to obtain this type of information beginning this spring with the

assistance of a tunable dye laser under development, to determine induced fluorescence, by Drs. P.B. Mumola (of NASA Langley) and H.H. Kim (of NASA Wallops Station).

Sediment analysis shows the quantity to be down nearly an order of magnitude on Dec. 3 as compared to Oct. 10, and the size range maximum shifted from 0.5-2 micron size range on Oct. 10 to the 2-4 micron size range on Dec. 3. The Oct. 10 water was influenced by recent flooding and the tide was approaching high tide, whereas the Dec. 3 data had high water and ebbing at the time of the satellite pass. In addition to these changes, there was a reversal of the sediment loads along the Chesapeake Bay Bridge Tunnel in that on Oct. 10 the larger load was on the south end, and on Dec. 3 the larger sediment load was in the central and northern areas. There seems to be a correlation between the sediment load count and the ERTS images.

Ground truth--turbidity

Development and testing of the continuously recording transmissometer system was completed in November, 1972, and monitoring of lower Chesapeake Bay surface waters commenced in December, 1972. Sea conditions permitting, turbidity has since been monitored during satellite overpasses on Dec. 3 and on January 26. So far, three baselines (Little Creek - Hampton, Hampton - Cape Charles, and Cape Charles - Little Creek) have been occupied at each of these times. Three baselines cross the three major boundaries of lower Chesapeake Bay: the bay entrance, Hampton Roads, and the lower central Bay.

The application of a transmissometer in this manner is essentially a new development, and is a practical means of delineating turbidity levels in estuarine water bodies. We have been able to determine these

for lower Chesapeake Bay, and have found them to be highly variable. Values range from 0 to 60% transmittance per 0.43 m, and are dependent upon 1) tidal stage, 2) water source, and 3) biologic activity. In addition, we have found short-term turbidity variations, often of high magnitude, occurring in some portions of the Bay, particularly in the central Bay and the northern Bay entrance. Correlation of turbidity with the baselines has been attempted as a preliminary step by microdensitometer, and was found not to be too promising because of the low contrast of the images. Correlation of the baselines to the bulk tapes is in an early stage, but appears to be considerably more successful. However, proper interrogation to extract the baselines from the tapes must still be made.

Bathymetry has also been determined along the above mentioned baselines, and shows some correlation to turbidity insofar as it affects flow of water masses within the Bay.

Image analysis--Data reduction

To date, imagery has been received for three passes over the experiment area; October 10, December 3 and January 26. The positive transparencies have been reduced, using the microdensitometer, and the radiance values for the green and red bands have been obtained for the 18 stations visited by helicopter and the three baselines in the Bay entrance. The data for the 18 stations has been tabulated to facilitate comparisons with the satellite imagery but no correlations have been attempted. At least three sets of data will be assembled before a rough correlation is attempted because the two sets to date are incomplete; the ground data for the baselines was not collected on October 10 and the Green band is missing for the December 3 pass (reason unknown). A rough comparison of the data seems to show some trend between the radiance values and the chlorophyll and particulate concentrations.

The photographic analysis is only used for quick look information and to assist in the final analysis with the Computer Compatible Tapes. At this time the reduction of the data on the tapes is continuing. A mask has been prepared to separate the land areas from the water. This mask will be printed to overlay CGS Chart No. 1222. In this way the resolution elements representing the ground test sites can be easily found.

NEW TECHNOLOGY

The use of a ship-mounted transmissometer to monitor turbidity of surface waters on a continuous basis is a new development. We are using a modified Bendix C-2 Transmissometer Probe with a shortened pathlength of 43 cm, to allow this instrument to be used in turbid estuarine waters. A continuously recording output in the form of a Mosely Model 80A-2 recorder was substituted for the standard manual readout, and adapted to the probe. A battery power-supply was also installed to increase signal-to-noise ratio (E.L. Bryant, 1973, Automatic recorder for a turbidity measurement probe, Langley Working Paper LWP-1097, 14 p.). Sensitivity of the modified instrument is well under 1% transmittance.

In order to use this instrument from a moving vessel, it was determined that the most feasible way is to mount the probe on the keel. This is accomplished by two Scuba divers in approximately 30 minutes before each cruise. We are using the Old Dominion University Institute of Oceanography research vessel LINWOOD HOLTON, a 65 foot T-Boat conversion, for this purpose. Cruising speed with the probe is about 6-8 knots.

PROGRAM FOR NEXT REPORTING INTERVAL

The program will include the following:

1. Continued monitoring of lower Chesapeake Bay during ERTS overpasses. Baselines will be extended into the lower portion of the central Bay, and water sampling will reflect the water structure found so far.

2. Use of a tunable dye laser to measure chlorophyll, and possible development by NASA-Langley of a high-speed, helicopter-towed transmissometer.

3. Processing of bulk tapes to correlate radiance to measured parameters, optimization of image data, and construction of contour maps of estuarine water parameters from the imagery.

CONCLUSION

The project is progressing as planned, but receipt of images has been less than anticipated. Ground-truth collection is proceeding satisfactorily, and is being modified by the results of available imagery and ground data. Image processing is somewhat hampered by a lack of material. Completion of results and interpretation of results will require that additional ground truth and imagery be obtained during the second half of this project.